MIRSI Call for Proposals 2022A

What is Offered

Discrete Filters: The discrete filters in the discrete filter wheel are available for use. The ZnSe window preclude using the filters at wavelengths > 18 microns on anything but exceptionally bright targets (i.e. we saw the Moon, but Jupiter was undetected).

Discrete Filter Wheel						
Position	**Center wavelength (microns)**	**Bandwidth (%)**	**Transmission (%)**	**Short Wavelength (microns)**	**Long Wavelength (microns)**	**Comment**
0 (home)	8.9	8.9	80	8.5	9.3	
1	BaF blocker					
2	CaF blocker					
3	4.9	20.9	70	4.45	5.45	M-band
4	7.9	9.0	65	7.6	8.3	
5	9.8	9.4	58	9.3	10.25	
6	11.9	9.9	60	11.3	12.5	
7	12.3	9.4	65	11.95	13.1	
8	10.6	45.8	65	8.5	13.0	N-band
9	12.28	1.5	65	12.17	12.36	
10	18.4	1.9	19	17.8	18.15	
11	20.6	37.4	55	16.8	>25	Q-band
12	2.2	18.2	70	2.0	2.4	K-band
13	17.5	2.3	25	17.3	17.7	
14	16.8	2.1	34	16.7	17.05	
Transmission: Peak transmission based on FTS scan in 2018						
Short and Long wavelengths: 50% of peak transmission, based on FTS scan in 2018						

MOC (MIRSI Optical Camera): MOC is expected to be available for 2022A. MOC is a clone of MORIS that will be co-mounted on MIRSI. It is fed by a dichroic, so that the IR beam is reflected into MIRSI while the visible beam is transmitted to MOC. Thus, MIRSI and MOC can be use simultaneously. MOC is intended to be used as a visible light guider for MIRSI, and also for visible light photometry. An eventual goal for MOC is to enable 'blind' image stacking of MIRSI images (where the target is too faint to be seen in individual MIRSI images), but this mode has not been tested yet and is not offered in 2022A. Since MOC is a clone of MORIS, we expect the sensitivity to be the same.

Scheduling: MIRSI can be used at any time during the semester, day or night. MIRSI can be swapped for SpeX or iSHELL within a half-hour during the night. Observing time on MIRSI can be requested in blocks as short as 1 hour.

What Is Not Being Offered

Chopping: Chopping is not offered with MIRSI, and MIRSI will be used with the non-chopping 'hexapod' secondary mirror.

Spectroscopy: We have not yet tested the grisms in MIRSI, and so spectroscopy is not offered in 2022A.

CVF: We have not yet tested the CVF in MIRSI, and so the CVF is not offered in 2022A.

Blind Stacking with MOC: While MOC is expected to enable blind stacking of MIRSI images (using the MOC image to align MIRSI images on targets too faint to see in a single MIRSI A-B pair), this has not been demonstrated and proposals should not expect to use MOC for blind stacking in 2022A.

Sensitivity

Most of the measurements mentioned here were done before recent work to optimize the array readout, and may not accurately represent the sensitivity of MIRSI in 2022A. These are currently our best estimates for MIRSI's expected capabilities.

Targets should be visible in a single A-B pair to enable alignment and stacking, thus this sets a limiting flux for MIRSI targets. During on-sky testing, the faintest star that we have been able to detect in a single A-B pair is about 1 Jy. On 109 Virginis (1.3 Jy), 1000 coadds of 10 ms exposures yields S/N~4. **Figure 1** shows that the sky noise decreases more slowly than sqrt(coadds), but rather the sky noise decreases as coadds^-0.35.

By aligning and adding dithered images, we were able to further decrease the sky noise. When aligning and adding dithered images, the sky noise seems to go down with the square root of the number of images added. By coadding one minute of data, we were able to get to S/N=11, thus the 1 minute 1 sigma sensitivity is 120 mJy.

Star	Flux at 10 um	Int. Time	Filter	S/N
109 Virginis	1.2 Jy	360 s	Broad N-band	34

Table 1: Observed S/N for a stack of 36 images, of 1000 coadds each, on 109 Virginis

Many of these measurements were done before recent efforts to optimize the array readout. Future changes may also improve the array performance.

Asteroid detection: We have attempted to observe a number of asteroids during MIRSI testing. Vesta was very bright. We were able to easily see 9 Metis (March 21, 2021) and 116 Sirona (March 31, 2021). We were able to faintly see 237 Coelestina (March 31, 2021), but we did not see 537 Pauly (March 21, 2021).

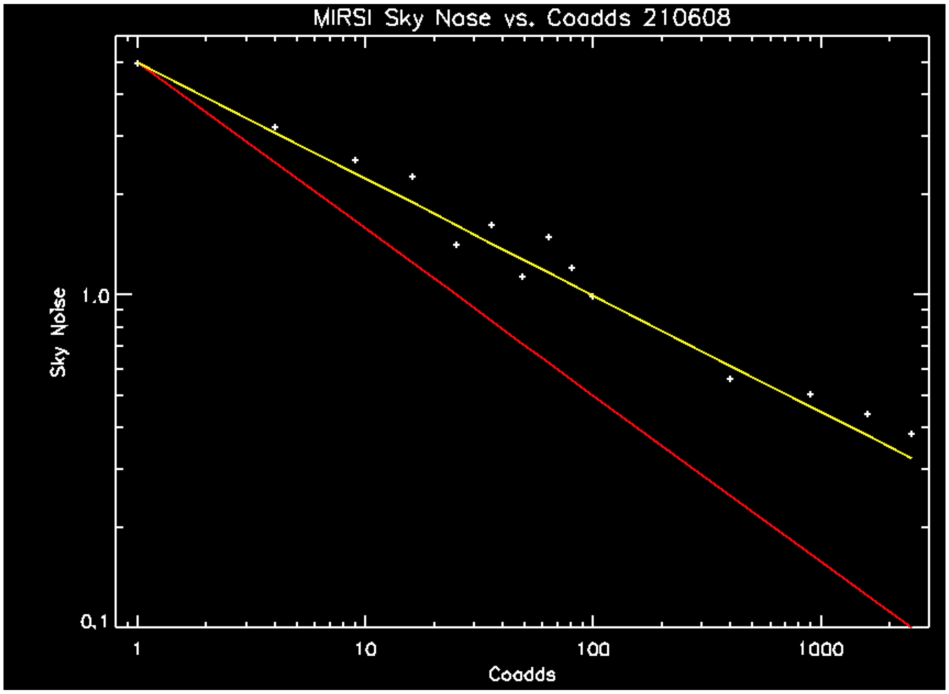

Figure 1: The sky noise decreases with coadds to -0.35 power (yellow), rather than with the square root of coadds (red).

Sample Images

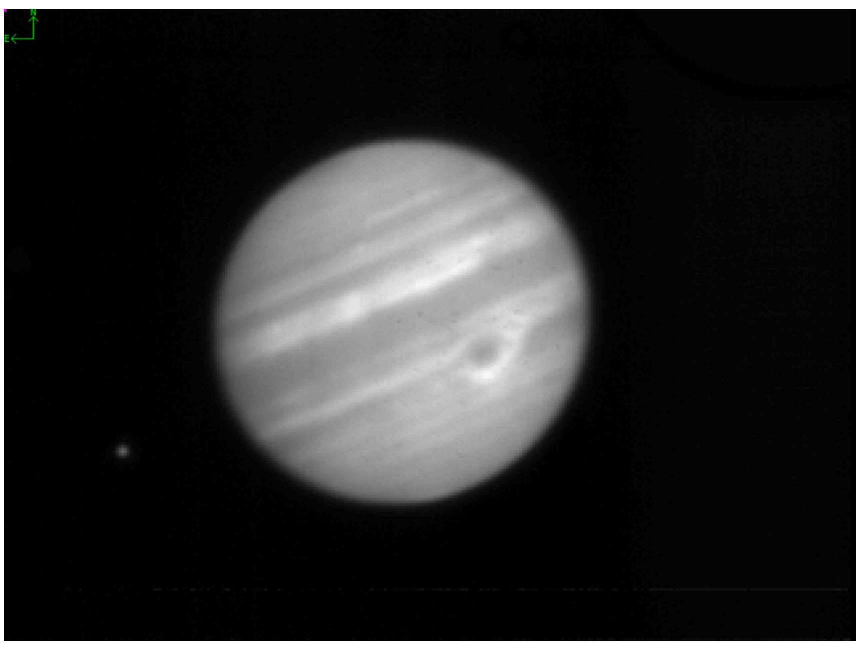

Figure 2: Stack of several images of Jupiter at N-band. Note Io to the lower left, and the GRS to the lower right.

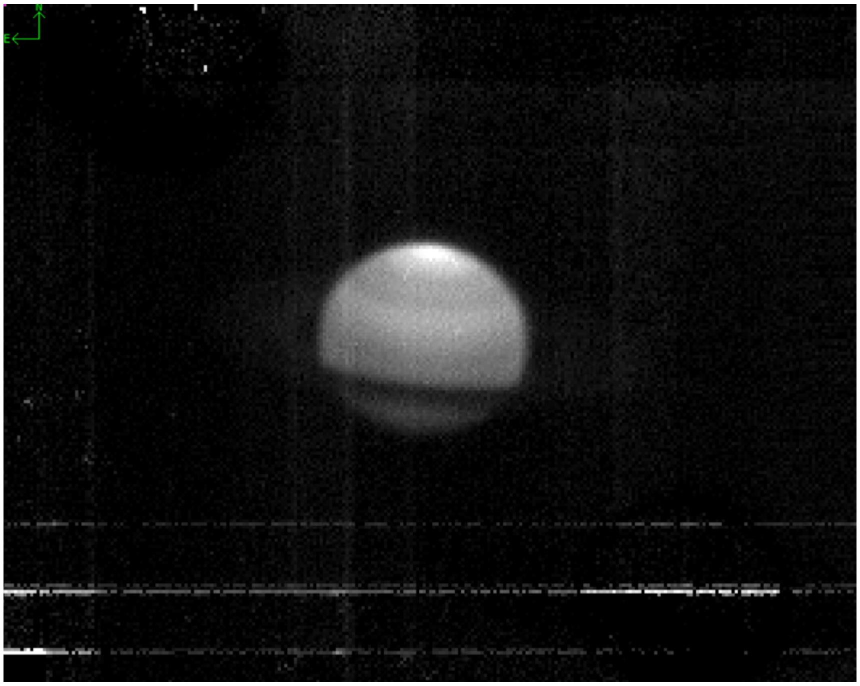

Figure 3: A stack of several images of Saturn, N-band.

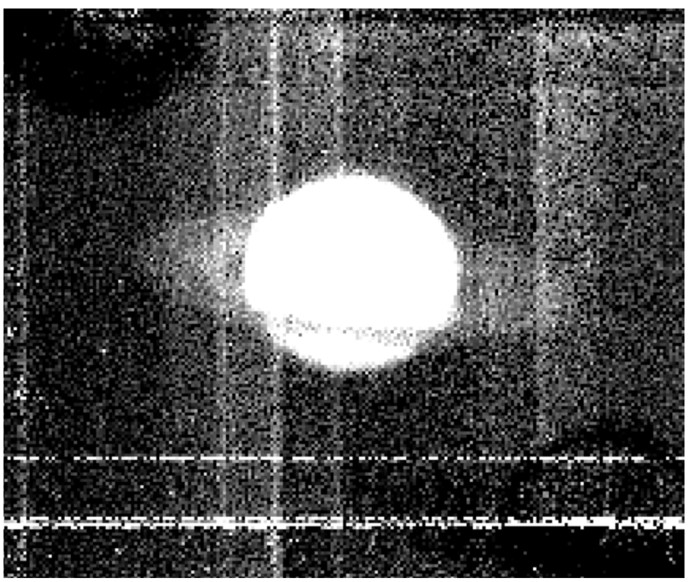

Figure 4: The same image as above, but stretched to show the rings. Total integration time is about 50 seconds.

Tips

1) Observe bright targets. 5 Jy sources are easily detected in an A-B pair. 1 Jy is near the limit on a clear night.
2) Dither frequently. The S/N seems to be better on the 2nd A-B pair than the first A-B pair after the array has been idle for a while. A good strategy may be to take a large set of dithered images and discard the first image or two.
3) Use enough coadds to see the object, and then align and add multiple images to further improve S/N. Increasing coadds doesn't beat down noise as fast as adding separate images, but taking separate images adds overhead for the dithering.

Questions? Please contact Mike Connelley (msc at ifa dot Hawaii dot edu)